

**ENERGY SURETY WHITE PAPER**  
**PREPARED FOR MAYOR AND BOARD OF TRUSTEES**  
**VILLAGE OF HIGHLAND FALLS, NEW YORK**  
**PREPARED BY EATON**  
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**EXECUTIVE SUMMARY**

The electrical grid in the United States is vulnerable to widespread and long-term service outage. These vulnerabilities come both from the complexity and age of the system, as well as from the rapidly increasing use of advanced electronics and computers to control the system. Threats to the grid can come from natural and manmade events, both of which have been experienced in the recent past across the country.

Extended grid outages pose significant challenges to national and homeland security, as well as the ability of state and local agencies to provide basic services to citizens and critical local institutions. The needs and responses that will ensure energy surety at the federal, state and local levels are quite similar, which provides opportunities for various government agencies in the same area to partner in the development and execution of common solutions to the problem.

Solutions are available today that can deliver assured power to critical infrastructure during a prolonged grid outage. Advanced microgrids serve as the backbone of the solution. Distributed power generation assets, owned locally and operated locally, and fueled by locally-available energy feedstock can provide energy resiliency and surety throughout an extended outage. Incorporating local power generation assets utilizing microgrid technologies, these installations should be developed maximizing the use of currently installed electrical infrastructure, while taking advantage of private sector financing and government grants and credits to reduce the overall costs of infrastructure upgrades.

**DEFINING THE RISK**

America's critical national security and homeland defense assets rest on a very unstable and fragile foundation. Almost exclusively, these essential assets and virtually every other electronic device that runs our daily lives depend on the electric grid as the primary source of power. The grid is one of our nation's most valuable assets, yet it has become increasingly vulnerable to natural events, such as massive storms and electrical disruptions from solar flares, as well as manmade events in the form of cyber,

electromagnetic pulse (EMP) and physical attacks from nation-states, rogue terrorist organizations or homegrown criminal elements. The threat presented here is not one of short term localized outages that can be adequately addressed via backup power generation. The threat we face is one of long term, wide ranging outages measured in weeks, months, and in worst case...years.

The vulnerability of the grid comes from the two ends of the technology spectrum. At one end, risk comes from the age and fragile nature of interconnections and components on the grid. That fragility exacerbates the level of damage such an event could inflict, and greatly lengthens the time necessary to recover the system and return it to operating status. On the other end of the spectrum, changes mandated by the U.S. federal government have resulted in upgrades made to the grid following September 11 and the great Northeast outage a decade ago. Those upgrades were made to increase the reliability, robustness and resiliency of the grid. However, those upgrades rely heavily on automation and computers to provide that stability, reliability and resiliency to the system. In addition, the United States and other countries are rapidly adding intermittent renewable energy generation resources to the mix of power generation assets. To effectively utilize these new power generation assets, and incorporate them into the grid, power system automation and engineering allows everything to work flawlessly together. These technologies ensure the quality, flow and balance of the power to the grid that satisfies the load requirement. They also complement the existing grid, while limiting any degradation. However, it is the computers and automation at the center of these smart systems which could be the most susceptible to the impacts of a cyber or EMP attack, or the significant impacts of a major natural disaster. The risk in a nutshell is: what happens if the smart grid goes dumb? Or even worse, falls under the control of an alien entity?

The US Northeast is no stranger to the impacts of major events impacting the electrical grid. In recent memory, of course, there is Superstorm Sandy. Of more particular interest and relevance to the area surrounding Highland Falls is the devastating effects of Hurricane Irene. These recent natural events paint a picture of the causes and potential impacts of a sustained grid outage - and this was only for a few days. From these events, however, the community has a basis for defining its "points of vulnerability" and efforts that should be undertaken to address those and evaluate others - as well as to ensure secure energy for identified critical infrastructure that is the life line for its citizens.

The threats posed to society also challenge our military and all agencies tasked with providing national defense and security of the homeland. The stakes, however, are significantly higher based on the criticality of the mission. Yet, evidence suggests that

our most critical national security infrastructure is no better protected against a catastrophic event than are private sector assets. Those tasked with ensuring resiliency of national security, homeland defense, and local civil defense/emergency response, will also be called upon to provide secure and dependable electrical power that ensures public safety and continuity of government/public services for its citizens.

## **THE SOLUTION**

The local communities that host our military installations are facing the same issues related to power surety as is the Department of Defense (DOD). Solutions appropriate to meet DOD needs should be quite adequate to meet local needs. This shared need opens up opportunities for collaborative efforts to build a comprehensive solution that can mitigate cost - based on both federal and local requirements. Larger scale normally translates into lower unit cost, making more projects financially viable. In addition, in the aftermath of September 11, Hurricane Katrina, Superstorm Sandy, and Hurricane Irene, many states are now beginning to offer grants to install infrastructure to address the need for power reliability and grid resiliency. New York State is reportedly close to issuing its microgrid/energy surety grant program. Partnering of local communities with federal installations might assist in securing grant funding that could buy down the cost of a project, thereby making some marginal projects quite viable.

Microgrids provide an excellent platform to operate critical assets over long periods of time in isolation from a damaged grid. The technology is available today to allow microgrids to function as distributed primary power generation assets during times when the grid is healthy and operating properly, while also having the capability to physically disconnect from the grid and operate in an islanding mode for extended periods of time powering critical infrastructure without interruption to the mission. As the grid is repaired and begins to recover, these microgrid generation assets will be available to provide a very important service. They can be designed to have the capability to provide black start for traditional large power plants, allowing them to power up and come back on line. The dedicated microgrids can then return to their normal operating mode, seamlessly reintegrating and running in parallel to the grid as distributed power generation.

## **BUT WHAT IS THE DEFINITION OF CRITICAL INFRASTRUCTURE?**

Traditionally, in the case of short-duration and limited outages, relief is provided by standby generators at the police and fire station...and maybe town hall...They provide adequate protection to "get by". But in the case of outages that could be wide ranging, with duration lasting weeks or months, the inventory of critical infrastructure that must

remain operational expands dramatically. Not only must the personnel who provide basic emergency services (police, fire, emergency responders) be serviced themselves, but also food stores, banks with ATMs, basic medical facilities, gasoline stations, as well as water and wastewater treatment plants, must remain operational - to ensure a basic quality of life for residents. As outages stretch in duration, residents will seek shelter requiring "islands of refuge" like schools, theaters, hospitals and universities. These must have enough energy available to provide food, lodging and basic hygiene to large groups of people. In simple terms, as the duration of a power outage grows longer, the breadth of need for "operating" critical infrastructure expands.

## **MOVING FORWARD**

When developing the strategy and execution plan to provide energy surety, each circumstance and the requirements that follow will be unique. For that reason, it is quite important that a careful analysis of risks and needs peculiar to each situation is fully reviewed and understood. From that analysis a comprehensive and tailored plan would be developed. Contingencies will be different in each instance, so they must be examined and specifically addressed in the action plan. Each mission critical asset (facilities and applications) will be identified by the customer and addressed in the plan in terms of energy needs and the criticality of each identified asset. Based on the customer identified critical assets, the amount of power, location of supply and storage infrastructure necessary to adequately support critical assets can be identified and designed into the system.

Once total supply requirements are determined, total on-site generation needs can be established and current available distributed generation assets will be assessed for their ability to support power requirements. Gaps in generation capacity will be translated into additional resources necessary to be added to the system and, in addition, proper siting of additional power generation assets will be determined, to best support the critical infrastructure electrical load. The final piece to the puzzle is the analysis of any energy feedstock supply chain requirements. A distributed power generation system is only as effective as its continually-available source of fuel to keep the system in continuous operation. This can be the "Achilles Heel" of the system, as the energy feedstock supply chain is normally taken for granted and not considered.

The properly designed system will have the capability of 24/7 operation on or off the grid, providing demand management capability to adequately control loads in order to allow the system to operate under all conditions effectively and efficiently.

## **FACTORS SPECIFIC TO HIGHLAND FALLS/WEST POINT**

Based on an initial visit to the area, it appears the Village has exposure in maintaining adequate water and wastewater services during an extended outage. Those issues appear to extend to West Point as well. In particular, wastewater treatment facilities draw a tremendous amount of electrical power, but their inherent ability to potentially generate power is often overlooked. This appears to be the case for Highland Falls. Effective use of methane off gassing and bio digesters to generate methane from sludge could provide a reliable fuel source for gas-fired reciprocating, turbine or fuel cell energy generation sets. In all likelihood, waste gas coupled with a natural gas source could ensure uninterrupted operation of the Village wastewater treatment plant before, during and after an event impacting grid supplied power. Ensuring a secure power source for the Village wastewater treatment plant could also serve to position the Village to expand and supply capability to the Academy, reducing the burden on West Point's antiquated system.

The Village is actually uniquely situated to provide secure energy to its water plant with ease. The speed and volume of water passing just above the water plant inlet is likely adequate to support an appropriately sized hydro-turbine, allowing for the power potential of the water flow to be extracted before that water enters plant inlet.

The Village is a bit constrained in terms of open space. However, the rooftops of critical facilities such as the schools, town hall, police and fire stations provide an opportunity to install rooftop solar with energy storage at the point of use. In addition, a four acre closed landfill near the high school offers an opportunity for the installation of a significant solar generation facility, and is relatively close to power lines that will reduce the cost of connecting the generation source to the point of use. The development of an overall solution would likely be done in stages over an extended period of time. However, certain components of the system could be designed and installed relatively quickly. The rooftop solar component is an example of a piece of the system that could be designed, financed and up and running in a relatively short period of time. Getting some "early wins" to show credibility of the overall effort should be considered not only to gain buy-in from important allies, but also to begin enjoying the benefits of the system as soon as possible.

Additional distributed generation sources are likely available in the area. Smaller combined cooling, heat and power units (CCHP) offer a very effective source of base load power generation. Based on the diversity of potential energy feedstock in the Highland Falls area, CCHP units might offer a very attractive alternative as a power generation source. Small hydro systems closer to the river should be considered. In addition, any community where municipal solid waste tipping fees are high, like New

York State, should consider if conversion of waste into electricity makes financial and environmental sense. The days of traditional trash burning units to generate electricity are long behind us. Modern gasification technologies are now available, offering disposal methods/distributed power generation capability that can, under the right circumstances, reduce costs and overall environmental impact at the same time.

Economies of scale often help to increase the affordability of distributed power systems. Potentially combining the interests of the Village, the school district and possibly the town could increase the size and scope of the overall system, driving down the unit cost of electrical generation. The long term goal of the initial exercise should be to position the Village to offer electricity and energy surety to the United States Military Academy, thereby providing the option of a much larger system in the future, including the financial returns associated with the much larger system.

Of course, the installation of any distributed power generation asset would have to undergo a review of environmental and other impacts before any construction were to begin. Based on the diversity of options available to the Village, some combination of options should likely provide an appropriate solution to provide the power necessary to keep critical infrastructure operational through a prolonged grid outage.

## **THE PUBLIC UTILITIES**

Public utilities are often criticized for acting as a roadblock to the development of distributed power generation/energy surety systems. While some of that criticism may be warranted, the fact is that utilities are obligated to ensure that quality and reliable power is available in their respective service territories. Distributed power systems must be able to seamlessly interface with the overall grid under normal operating conditions, be capable of islanding during periods of grid failure, and then again seamlessly reintegrate with the utility grid once power is restored. In certain cases, the utility may actually rely on distributed power generation systems to provide demand response, black start or other capabilities necessary for effective management of a healthy grid. Although the construction of a rudimentary stand-alone microgrid may be a relatively simple task, the complexity of the engineering of a system that interfaces smoothly and effectively with the overall grid requires the experience of engineering teams with deep experience in the utility space and credibility with the particular utility affected.

Orange & Rockland should be considered as a key potential player in the proposed project. The fact that O&R appears to own the electrical distribution system for the Village and likely most of the system on West Point, makes the need for collaboration with the utility even more critical. Eaton has deep ties with the Consolidated Edison,

Inc. family of which Orange & Rockland is a member. Eaton has been in discussions with O&R sister company Con Edison Development, Inc., which has 150 MW of solar projects in various stages of development and some experience in combined heat and power (CHP) development. The ConEd family, partnered with Eaton, could be a potential source of project financing, project ownership or other roles within the overall project development and long term operation life cycle.

## **PAYING FOR IT**

Current and future government budgetary constraints may provide little or no room for direct federal, state or local government energy surety investments. Certainly, there will be opportunities for government financed projects, but the lion's share of projects will have to seek money from other sources. So, alternative paths to successful solutions must be sought. Private sector solutions, developed in partnership with relevant federal, state and local agencies, provide a pathway to the desired end. But, private sector solutions require a financial return for investors.

That financial return can come in the form of providing power to a consumer, providing demand response capability, and/or providing black start capability to get large power plants back on line after an outage. Microgrids that operate in parallel to the grid when the system is fully operational, yet can island critical infrastructure in the event of catastrophic failure, will generate revenue as distributed primary power operating 24x7. Demand response and black start assets are compensated through charges to utility rate payers based on their availability to meet a defined need. Not all power generation technologies and not all locations can currently offer pricing that will support a financially viable project. However, high utility rates in many parts of the country suggest that distributed microgrid systems could be designed that could generate a private sector return today. Based on current utility rates in New York State, this area is an attractive locale for private financing of distributed/microgrid systems.

## **CONCLUSION**

The risk to human health and welfare from extended outages to the electrical grid is a call to action to ensure that secure sources of power are available to provide basic services on an uninterrupted basis, regardless of the duration and scope of a power outage. Secure microgrid systems provide a viable solution for government entities at the federal, state and local level, ensuring energy surety in the face of an extended grid outage. Municipal governments like the Village of Highland Falls have very viable options available today to address these risks, with financial vehicles available to assist if government financing is not an option. The Village has one unique attribute. It plays

host to the United States Military Academy at West Point, a national treasure and asset critical in the training of those who will defend this nation against foreign aggression. The Village is uniquely positioned not only to develop an energy surety solution that will protect the municipality's critical infrastructure, but also to ensure the continuous operation of the US Military Academy.

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